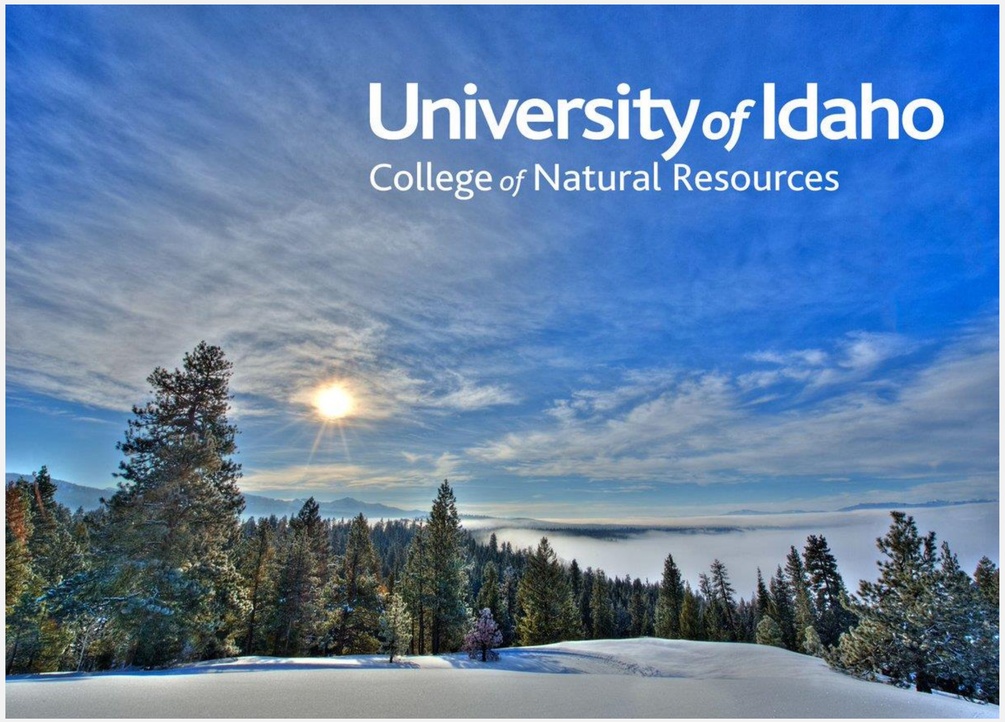
University of Idaho
College of Engineering

ALTERNATE AQUACULTURE VACCINE DELIVERY SYSTEM

TEAM FISH-VAC
BEN, CODY, HASAN

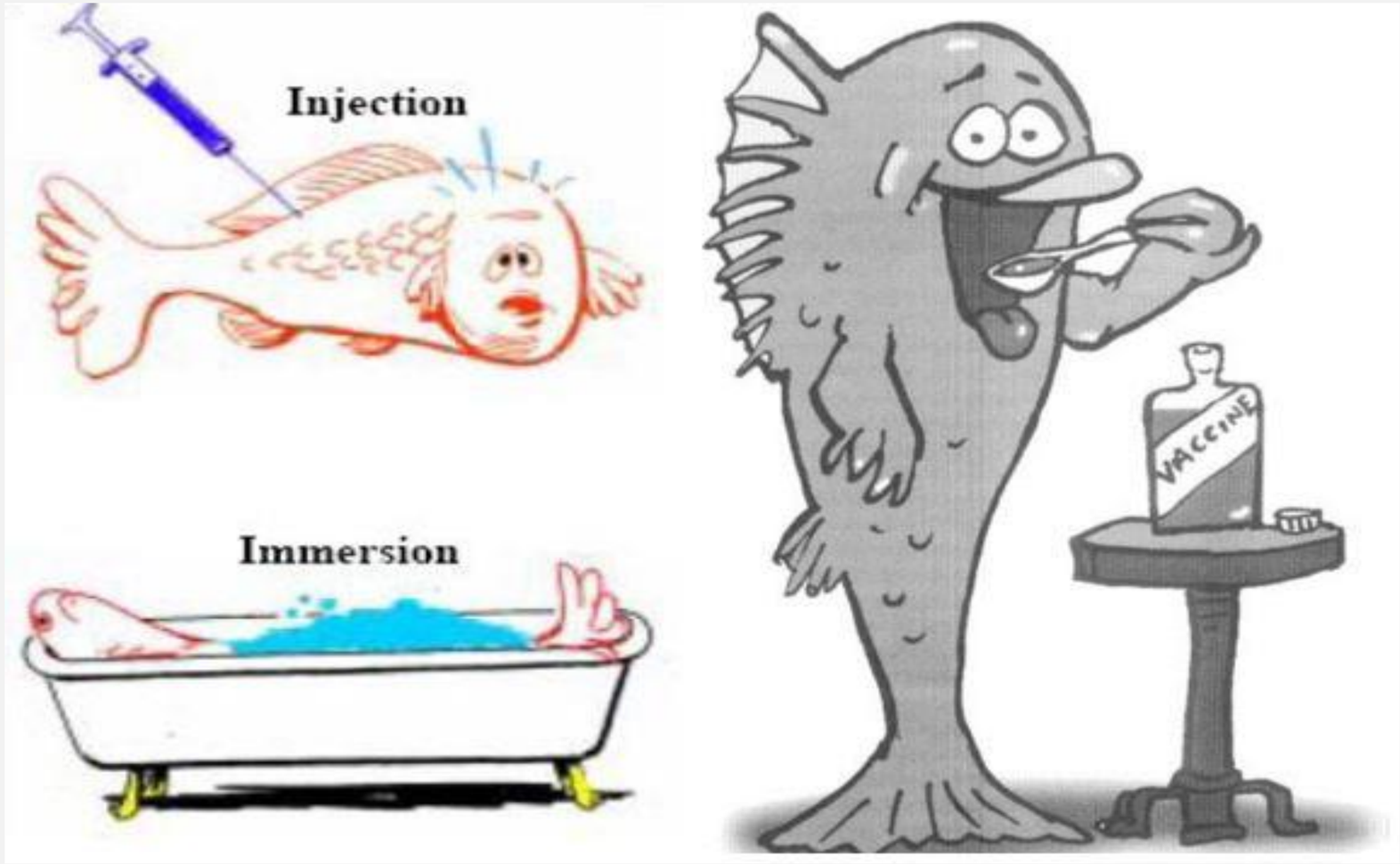
PROBLEM BACKGROUND

Vaccination has taken many forms over the years. Starting with humans and spreading throughout our domesticated and farmed species. For most of us our vaccination comes through needles. This practice works wonders but is a daunting task looking at thousands of 1-2g salmonids. The problems facing engineers are numerous, and in our case, assisting the College of Natural Resources we can bring about new change.



VACCINE DELIVERY METHODS

- Injection
  - Via needle and syringe
- Oral
  - Incorporated in the fish's feed
- Immersion
  - Fish are placed into vaccine water solution and the vaccine is absorbed through skin and gills



ENHANCING VACCINE UPTAKE

- Small punctures or removal of a fin prior to immersion results in enhanced vaccine uptake
- Goal is to design a vaccination system that incorporates both vaccination methods to increase uptake

VALUE PROPOSITION

- Vaccinating large quantities of fish efficiently saves money and strenuous effort
- Creating an instrument that is easy to use and cheap to maintain is important for the consumer and the supplier.
- An effective and well-engineered product is our goal.

PRODUCT REQUIREMENTS

- Should contain non-specific parts where possible to allow for easy repair
  - Standardized hardware/needles
  - Regular Arduino style motors
  - 120v supply for electrical components
  - Agricultural water circulation pump available at most hardware stores
  - Designed to be used with existing vaccination tubs
- Two Prototypes (Lab model and production model)
  - Lab size model for proof of concept testing
  - Functioning Prototype model for IACUC approval and testing
  - Full scale prototype for research and advancement

PRODUCT REQUIREMENTS

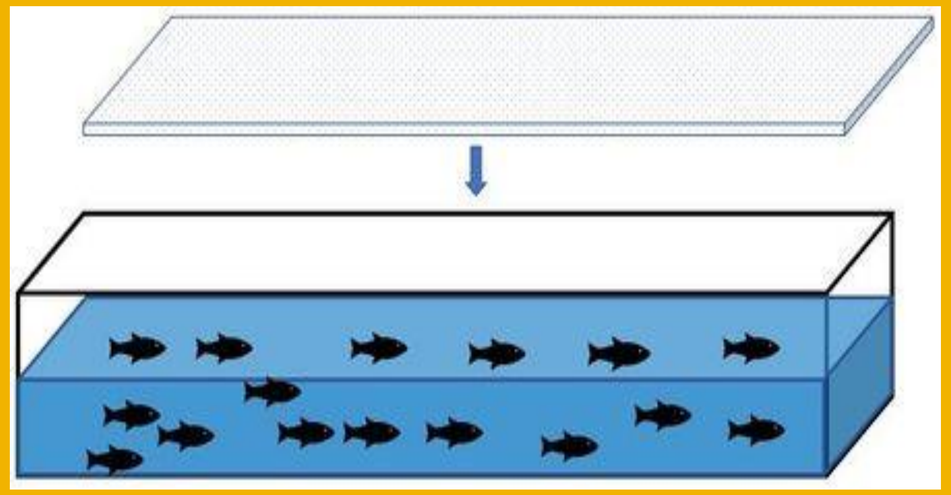
Product should be adjustable to vaccinate a variety of different sized fish

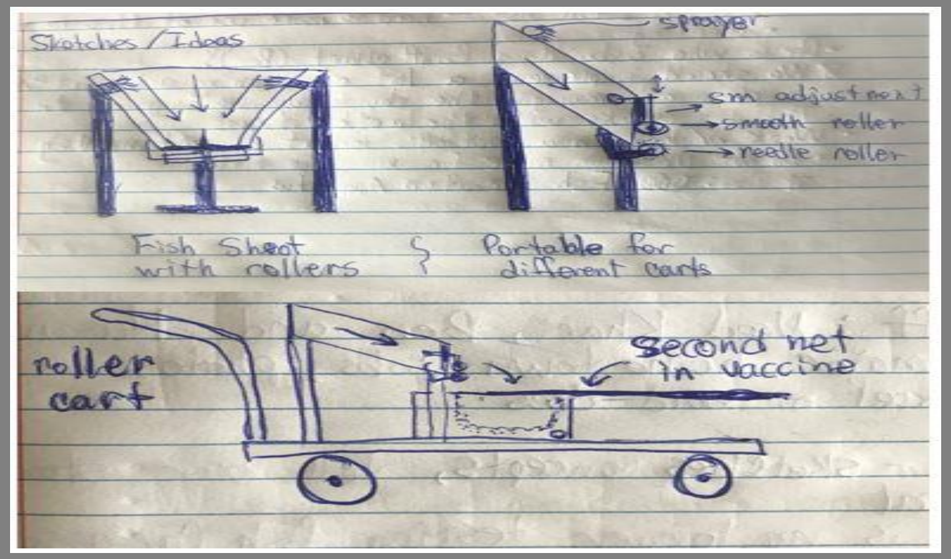
- Prototype must be able to process fish with the widths varying from 3/16" wide to 9/16" wide fish

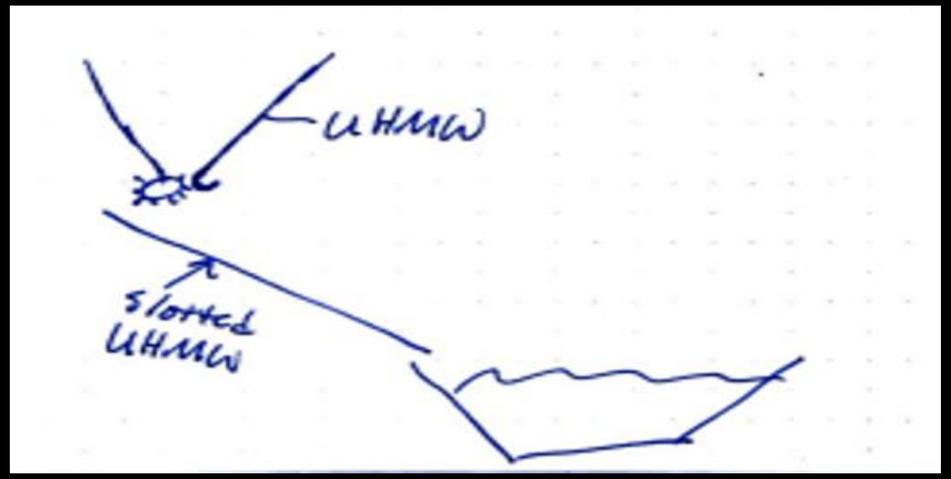
Humane method of puncturing the fish

- Needle size for injection vaccine is 21-22guage and we are using 25guage needle to decrease potential damage
- Standard needle depth is 1mm and we are significantly less (PharmaQ)
- Probability of puncturing eye of the fish 0.2
- Initially test without needles to prove system

BRAINSTORMING STAGE





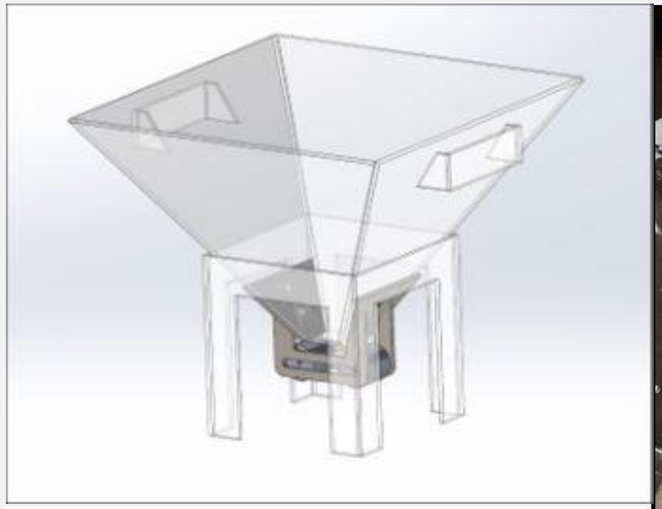


PROTOTYPING EVOLUTION

Cardboard Lab prototype model

PROTOTYPING EVOLUTION

Initial acrylic Lab prototype model testing with euthanized fish



PROTOTYPE DESIGN VALIDATION APPROACH

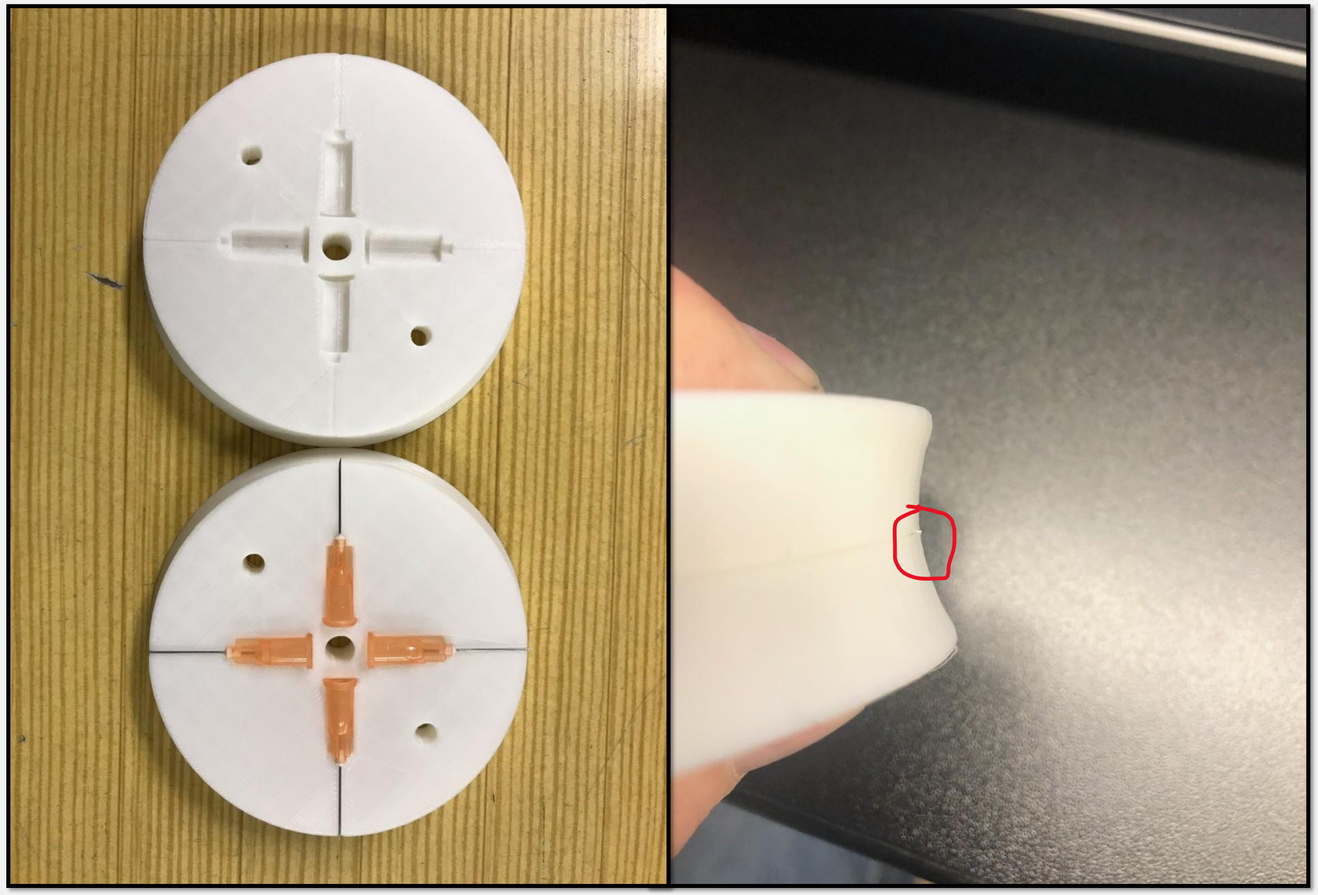
- **Started testing** 8/31/2020
  - Tested initial lab prototype
- **Initial prototype** 9/4/2020
  - Tested same lab prototype with various decreased needle densities
- **Initial prototype** 9/30/2020
  - Modified initial prototype to accept new 3D printed rollers

TESTING RESULTS

- **Started testing** 8/31/2020
  - Tested initial lab prototype
    - Test failed. We had to apply to much pressure and could not achieve puncture without damaging the fish.
- **Initial prototype** 9/4/2020
  - Tested same lab prototype with various decreased needle densities
    - Test failed after trying 3 different needle densities. Change of density included increasing space between needle disks, and individual removing 2 out of every 3 needles from disks.
- **Initial prototype** 9/30/2020
  - Modified initial prototype to accept new 3D printed rollers
    - Tested new 3D printed rollers with hypodermic needles. Test **Success** we were able to orient fish with the rollers and achieve puncture under body weight.

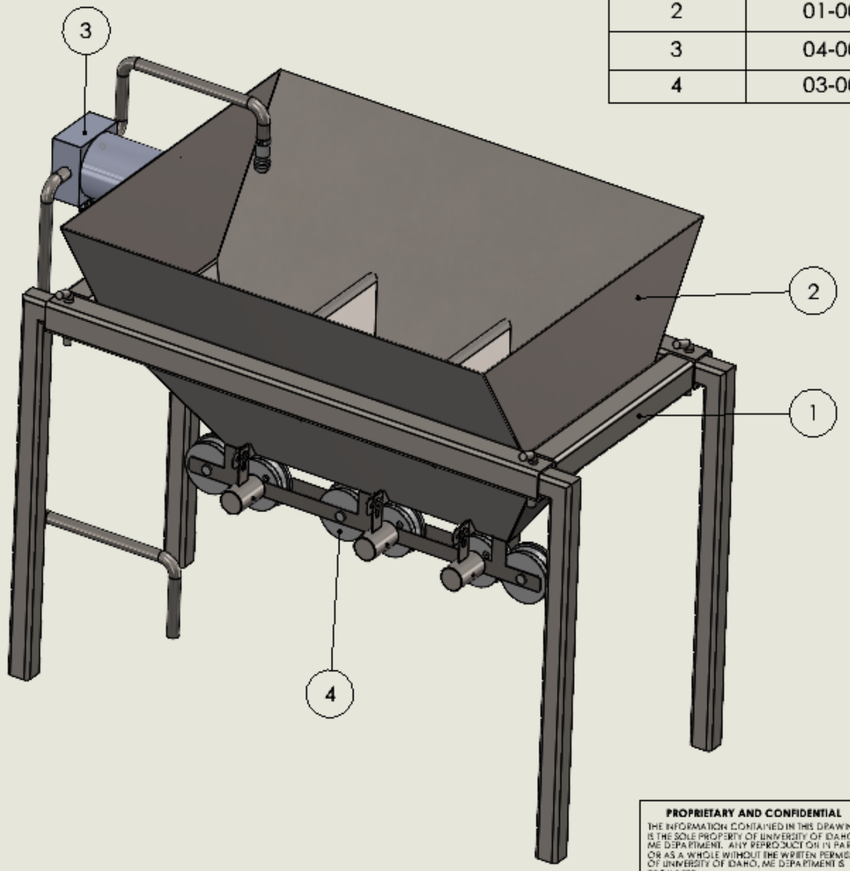
PROTOTYPING EVOLUTION

Improved 3D printed Rollers allowing for standard hypodermic needles



FINAL MODEL ASSEMBLY

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	02-00	Frame Assembly	1
2	01-00	Chute Assembly	1
3	04-00	Pump Assembly	1
4	03-00	Needle Roller Assembly	3



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DIMENSIONS ARE IN INCHES
THIRD ANGLE PROJECTION

Team Fish Vac.

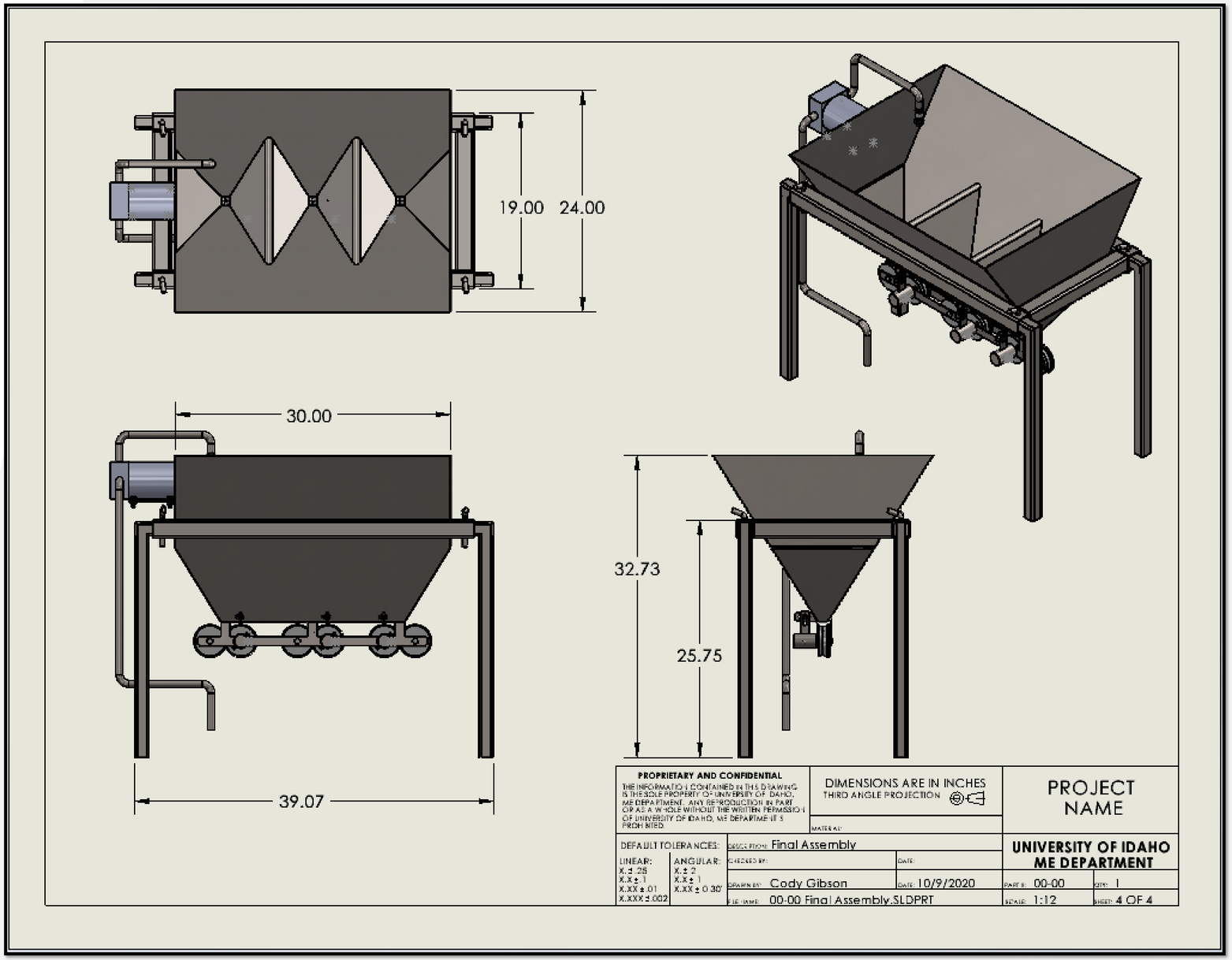
DEFAULT TOLERANCES:
LINEAR: X ± .25, X.X ± .1, X.XX ± .01, X.XXX ± .005
ANGULAR: X ± 2, X.X ± 1, X.XX ± 0.30

DESCRIPTION: Final Assembly
CHECKED BY: DATE:
DRAWN BY: Cody Gibson DATE: 10/9/2020
FILE NAME: 00-00 Final Assembly.SLDPRT

UNIVERSITY OF IDAHO
ME DEPARTMENT

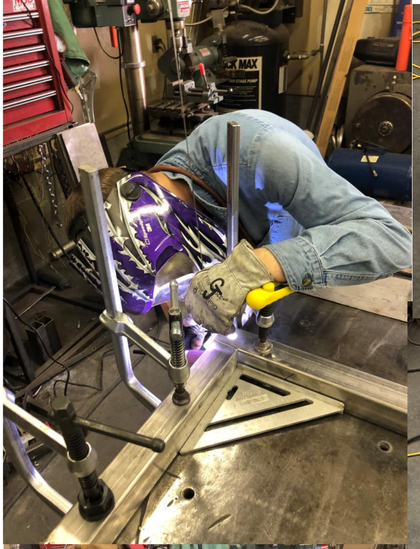
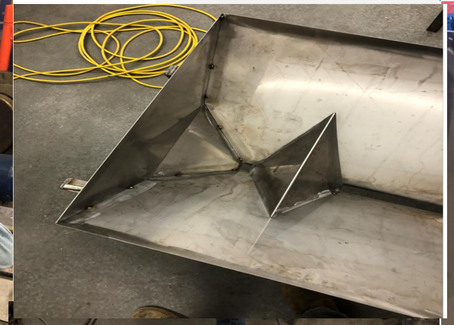
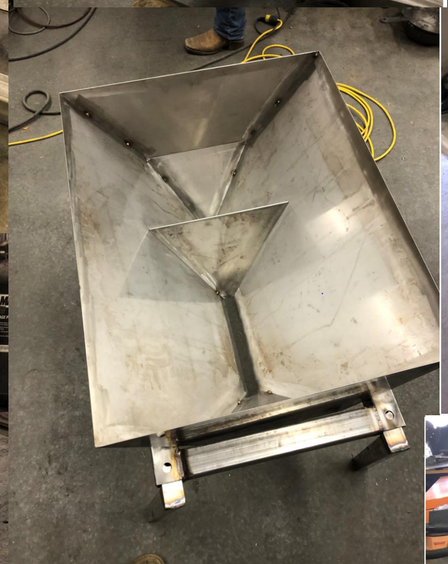
PART #: 00-00 QTY: 1
SCALE: 1:8 SHEET 1 OF 2

FINAL MODEL ASSEMBLY



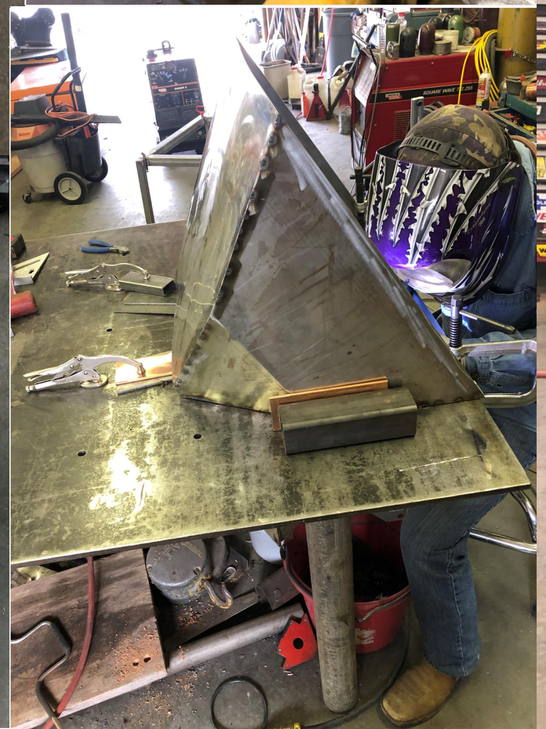
MANUFACTURING PLAN

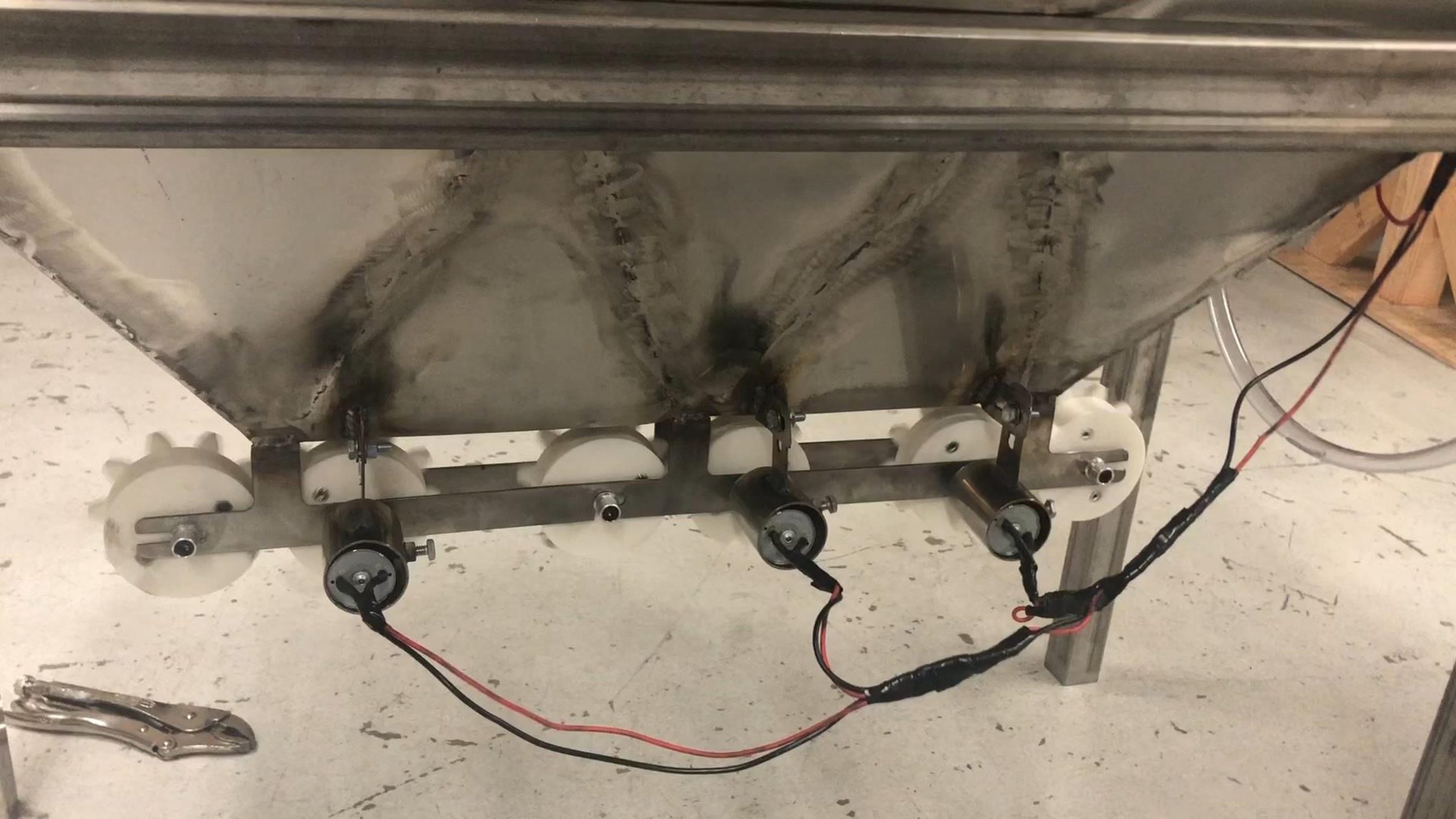
Indented Bill of Materials (BOM)			Manufacturing Plan							Cost	
Part No. or Assy No.	Description	Quantity	Make or Buy?	Source (or Fabrication Location)	Fabrication Technique (if appl.)	Is the Drawing Avail.?	Is the Material Avail.?	Who will lead (Name)?	Target Completion Date	Unit Cost ($)	Extended Cost ($)
Full Assy 1											$ -
Subassembly 1	Chute	1	N/A	N/A	N/A	N/A	N/A	N/A	N/A		$ -
Subassembly 2	Frame	1	N/A	N/A	N/A	N/A	N/A	N/A	N/A		$ -
Subassembly 3	Needle Roller	1	N/A	N/A	N/A	N/A	N/A	N/A	N/A		$ -
Subassembly 4	Pump	1	N/A	N/A	N/A	N/A	N/A	N/A	N/A		$ -
Subassembly 1	**Chute**	**1**								$ 401.50	$ 401.50
Part 5	Side Panel	2	Make	JML/Personal Equipme	Plasma Cut/Tig Weld	Yes	Yes	Ben	6-Nov		$ -
Part 6	Front Panel	2	Make	JML/Personal Equipme	Plasma Cut/Tig Weld	Yes	Yes	Ben	6-Nov		$ -
Part 7	Divider Insert	2	Make	JML/Personal Equipme	Plasma Cut/Tig Weld	Yes	Yes	Ben	6-Nov		$ -
Part 8	Roller Mount (Gear Side)	1	Make	JML/Personal Equipme	Plasma Cut/Tig Weld	Yes	Yes	Ben	6-Nov		$ -
Part 9	Roller Mount (Motor Side)	1	Make	JML/Personal Equipme	Plasma Cut/Tig Weld	Yes	Yes	Ben	6-Nov		$ -
Part 10	Motor Mount	3	Make	JML/Personal Equipme	Plasma Cut/Tig Weld	Yes	Yes	Ben	6-Nov		$ -
Part 11	Motor Mount Bracket	3	Make	JML/Personal Equipme	Plasma Cut/Tig Weld	Yes	Yes	Ben	6-Nov		$ -
Part 12	Motors	3	Buy	Amazon	N/A	No	Yes	Ben	6-Nov	$ 13.99	$ 41.97
Part 13	Set Screw	3	Buy	ME Shop	N/A	No	Yes	Ben	6-Nov		$ -
Part 14	3/16"x1" Hex Head	3	Buy	ME Shop	N/A	No	Yes	Ben	6-Nov		$ -
Part 15	3/16 Lock Nut	3	Buy	ME Shop	N/A	No	Yes	Ben	6-Nov		$ -
Subassembly 2	**Frame**	**1**								$ 273.00	$ 273.00
Part 16	Frame Side	2	Make	Personal Equipment	Plasma Cut/Tig Weld	Yes	Yes	Cody	6-Nov		$ -
Part 17	Frame Front	2	Make	Personal Equipment	Plasma Cut/Tig Weld	Yes	Yes	Cody	6-Nov		$ -
Part 18	Adjustable Leg	4	Make	Personal Equipment	Plasma Cut/Tig Weld	Yes	Yes	Cody	6-Nov		$ -
Part 19	Adjustable Leg Pin	4	Buy	Spence Hardware	Plasma Cut/Tig Weld	Yes	Yes	Cody	6-Nov	$ 3.50	$ 14.00
Subassembly 3	**Needle Roller**										$ -
Part 20	Needle Roller Motor Side	3	Make	GJ 125	3D Printer	Yes	Yes	Cody	6-Nov		$ -
Part 21	Needle Roller Driven	3	Make	GJ 125	3D Printer	Yes	Yes	Cody	6-Nov		$ -
Part 22	Needle Roller Geared	6	Make	GJ 125	3D Printer	Yes	Yes	Cody	6-Nov		$ -
Part 23	Axle Stub	9	Make	GJ 125	3D Printer	Yes	Yes	Cody	6-Nov		$ -
Part 24	Needles	24	Buy	Amazon	N/A	N/A	Yes	Cody	6-Nov	$ 0.20	$ 4.80
Subassembly 4	**Pump**										$ -
Part 24	Pump	1	Buy	Used Farm Equip	N/A	No	Yes	Ben	6-Nov	$ -	$ -
Part 25	Pump Bracket	1	Make	Personal Equipment	Plasma Cut/Tig Weld	Yes	Yes	Ben	6-Nov		$ -
Part 26	Spray Ball	1	Buy	Spence Hardware	N/A	No	Yes	Ben	6-Nov	$ 30.00	$ 30.00
Part 27	3/8"x5/16" Hex Head Bolt	3	Buy	ME Shop	N/A	No	Yes	Ben	6-Nov		$ -
Part 28	Spray Ball Bracket	1	Make	Personal Equipment	Plasma Cut/Tig Weld	No	Yes	Ben	6-Nov		$ -
Part 29	Hose	6	Buy	Spence Hardware	N/A	No	Yes	Ben	6-Nov	$ 0.69	$ 4.14
Insert more lines as needed...											
										Total BOM Cost	**$ 769.41**









FINAL PROTOTYPE DESIGN VALIDATION APPROACH

- Test for ten minutes with no needles to estimate the number of fish that can be processed per hour
- Apply for IACUC approval to test
- Perform tests on euthanized fish
- Start testing live fish Upon IACUC approval in the spring

COST/BUDGET

Capstone Project Budget - Summer/Fall

Project: Fish Vacination Apparatus

Last Updated 11/10/2020

Expense Items	2020 July	Aug	Sept	Oct	Nov	Dec	Item Total
Supplies / Parts / Services:							
Acrylic Sheet	$ 12.99						$ 12.99
Bonding Agent	$ 7.90						$ 7.90
Roller Mount		$ -		$ 20			$ 20.00
Final Material				$ 334			$ 334.00
Cutting/Shaping					$ 85		$ 85.00
Needles/roller			$ 10		$ 32		$ 42.28
Stand material				$ 150			$ 150.00
Fasteners			$ 50				$ 50.00
Pump/Hoses					$ 116		$ 115.91
Rapid Prototyping							$ -
120v to 12v converter					$ 18		$ 17.98
Motors					$ 44		$ 44.49
Cam Locks					$ 22		$ 22.23
Consumables					$ 100		$ 100.00
Facilities shop (1hr)					$ 43		$ 42.50
						Totals	**$ 1,045**

$ 2,000 Budget

$ 955 Excess

SCHEDULE

Fish-Vac Project Schedule

Project: Alternate Aquaculture Vaccine Delivery System
Last Updated: 10/6/2020

Complete
In Progress
Future

Milestones	Task Description	Duration	Assign To	6/15	6/22	6/29	7/6	7/13	7/20	7/27	8/3	8/10	8/17	8/24	8/31	9/7	9/14	9/21	9/28	10/5	10/12	10/19	10/26	11/2	11/9	11/16	11/23	11/30	12/7	12/14	12/21
			Year	2020																											
			Month	June			July				Aug				Sept					Oct				Nov					Dec		
Snapshot 1																															
7/13/2020	Define the requirements	2 Weeks	Ben		0%	100%																									
	Brainstorm concepts	3 Weeks	Team			0%	50%	100%																							
	Initial Plan for Development	3 Weeks	Cody				0%	50%	100%																						
Snapshot 2																															
8/6/2020	Design Validation	3 Weeks	Ben/Cody														0%	50%	100%												
	Design Validation IACUC approval	3 Weeks	Ben/Cody																	25%	50%	75%	100%								
	Needle Testing	2 Weeks	Team					0%	100%																						
	Initial Design Proposal	1 Weeks	Team						100%																						
	Value Proposition	2 Weeks	Ben							0%	100%																				
	Lab Test Prototype	5 Weeks	Ben											0%	20%	40%	60%	80%	100%												
	Lab Testing	6 Weeks	Ben												0%	20%	40%	60%	80%	100%											
7/27/2020	Concept Design Review (Bench Test Model)	2 Weeks	Cody						0%	100%																					
9/17/2020	Request Extension for Engineering Release Review	1 Day	Ben														100%														
9/25/2020	Design and print new needled rollers	1 Week	Cody														100%														
9/28/2020	Test Fit needles in new needle roller	1 Day	Cody															50%	100%												
9/28/2020	Review and Update all PM documentation	1 Week	Ben/Hasan															25%	50%	75%	100%										
10/5/2020	Submit Final Drawing Package to Max for Review	2 Weeks	Cody															33%	66%	100%											
10/5/2020	Complete Final Prototype Manufacturing Plan	2 Weeks	Ben/Cody/Hasan															33%	66%	100%											
10/7/2020	Submit Engineering Release Review Documents to Swenson	2 Weeks	Ben															33%	66%	100%											
10/9/2020	Engineering Release Review	1 Day	Ben/Cody/Hasan																	100%											
10/12/2020	Order all necessary raw materials/parts	2 Weeks																			50%	100%									
Snapshot 3																															
10/15/2020	Engineering Release (Drawings)	6 Weeks	Cody												0%	20%	40%	60%	80%	100%											
	Prototype test results	1 Weeks	Team																100%												
	Final prototype design validation	To Be Cont																													
10/21/2020	ERR updates review	1Week	Cody																		0%	100%									
Snapshot 4																															
12/6/2020	Final Protoype	11 Weeks	Ben													0%	11%	22%	33%	44%	55%	66%	77%	88%	100%						
	Validation and Testing	To Be Cont																								0%	33%	66%	100%		
	Final Portfolio	3 Weeks	Cody																								0%	50%	100%		

MOVING FORWARD

Design structure testing

- After completion of assembly, we identified weak points that could potentially lead to failure (namely the mounting of the rollers to the motors)

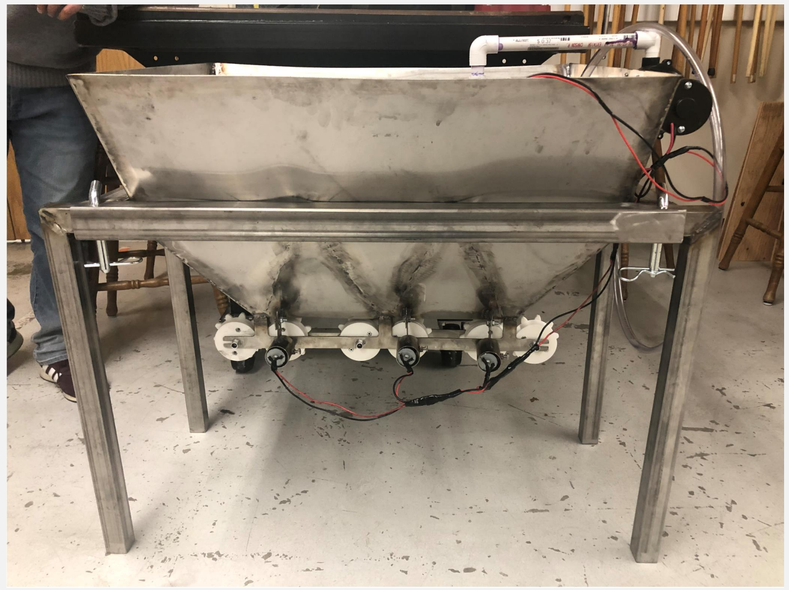
Sedated fish volume testing

- Test prototype to identify the number of fish that can be processed per hour without needles

Sedated fish puncture testing

- Test a group of fish and identify the percentage that receive punctures

Live fish vaccine trials



QUESTIONS?